

United States Patent Application
for an
OPEN INTERNET PROTOCOL SERVICES PLATFORM

TO THE COMMISSIONER OF PATENTS AND TRADEMARKS:

Your petitioners pray that letters patent may be
granted to them as inventors of an **OPEN INTERNET PROTOCOL
SERVICES PLATFORM** as set forth in the following
specification.

BACKGROUND

[0001] Cross Reference to Related Applications: This document claims priority to, and incorporates by reference all of the subject matter included in the provisional
5 patent application filed 02/27/01, entitled **OPEN INTERNET PROTOCOL SERVICES PLATFORM AND TOPOLOGY FOR USE.**

[0002] The Field Of The Invention: This invention relates generally to the creation of open Internet
10 Protocol (IP) management tools and services.
Specifically, the present invention is a network tool that integrates and performs the functions of multiple network related services in an Open IP Services Platform, wherein these services are typically performed by discrete
15 components.

[0003] Background of the Invention: Access to the Internet or other global information networks is generally becoming a commodity as Service Providers (SPs) and Local
20 Exchange Carriers (LECs) look to new value-added applications and services in order to retain customers,

attract new business clients, and generate revenue.
Enterprises face a limited supply of certified network
administrators, increased demand for high-bandwidth
network services, and the need to reduce the total cost of
ownership while preserving existing infrastructure
investments.

[0004] Unfortunately, existing solutions for SPs and
LECs fall short in a number of important areas. For
example, most customer-premise equipment (CPE) is not
Telco quality, thus resulting in inconsistent, unreliable
service and problematic service agreements. Next,
integration between network devices from a variety of
vendors is difficult at best. Furthermore, a lack of
extensibility and flexibility makes CPE difficult to
scale. New application services can require a large
upgrade, or at least a visit to the customer to modify or
replace equipment. There are almost always new costs
associated with every new piece of Internet Protocol (IP)
functionality, as well as additional management issues.
Finally, each piece of equipment requires a separate
management interface, preventing network-wide visibility.

[0005] The issues above all combine to prevent delivery

of revenue-generating, differentiated IP services to an increasingly demanding customer base.

[0006] Current network designs typically require a discrete piece of equipment for each network function to be performed. For example, an Enterprise will typically include network devices that interface with desktop computers and servers, and connect them to the Internet or other network. The network devices includes servers, switches, routers, bridges, firewalls, load balancers, packet shapers, etc. Managing this wide conglomeration of network devices requires a significant amount of time and vendor-specific expertise.

[0007] As network requirements expand and change, the need for specialized network services also changes. For example, repositioning a single network device within a network architecture disadvantageously necessitates both network downtime and a physical presence to make the changes. It is useful to examine a typical network configuration for an Enterprise to better understand the problem.

[0008] Figure 1 is an illustration of a typical network topology 10 of the prior art. The interface between

desktops 12 and servers 14 to a network, such as the Internet 16, typically includes network devices or components such as a router 18, a firewall 20, a packet shaper 22, and at least one switch, but where two switches 24, 26 are shown in this figure. Another server 28 might also be part of this interface, when the server is providing network services such as in an SQL server, DNS server, Web server, etc.

[0009] Each of the discrete components listed above is disposed within its own "box." Each box occupies a certain amount of space, or footprint. Furthermore, each box must also have its own power supply.

[0010] It would be an advantage over the state of the art to provide network administrators with a network architecture and system tools that would provide a consolidated, flexible, scalable, and less complex management solution that can be customized according to a customer's needs. Such a solution should enable network components, both the hardware and the software, to be included from any vendor. It would also be an advantage to decrease the level of complexity of the solution such that management tasks can be performed by a person with

limited computer network and vendor-specific knowledge.

[0011] In order to assist the network administrator, it would also be an advantage to provide a plurality of pre-configured or "canned" network configurations. Thus, for relatively simple network configurations, the administrator would not even have to design the network topology, as long as the available network components matched the canned network configuration.

[0012] It would also be an advantage over the prior art to provide a solution where the network configuration can be modified on the fly. The system should also be capable of enabling control of the system, if desired, down to single network port control, or sophisticated enough to manage all of the network ports as determined by network conditions.

[0013] It would also be an advantage to provide a plurality of these systems such that they can be coupled together in a large network, be it the Internet, or a more localized WAN or LAN topology. The system should also enable spare processing capability to be made available for other applications, without degradation of the network functions being performed.

[0014] It would also be an advantage to provide third parties with the ability to have greater control of how their plug-in hardware or software operates with the invention by enabling programming of ActiveX modules that enable components to be dragged and dropped in a control and management interface into desired network configurations.

[0015] Security of state of the art network devices is also a problem because embedded devices typically utilize a modified version of operating system software. The modified version is typically scaled down so as to include limited features. Therefore, it would be an advantage over the prior art to provide a system that utilizes a complete Operating System that can take advantage of the full range of Operating System's capabilities, including security features.

[0016] Summary of Invention: It is an object of the present invention to provide a system that enables multiple network functions to be performed within a single device.

[0017] It is another object to provide the system

wherein a single unit can perform any combination of the functions of a router, bridge, load balancer, firewall, packet shaper, switch, server, or any other network devices.

5 **[0018]** It is another object to provide the system wherein the interconnections between the functions can be modified through software.

10 **[0019]** It is another object to provide the system wherein the interconnections can be modified without taking the network down to make the changes.

15 **[0020]** It is another object to provide the system wherein a complete Operating System is utilized to thereby take advantage of all the security features that are available.

20 **[0021]** The present invention is embodied in a system comprising an Open IP Services Platform that provides any combination of functions of common network devices such as routers, bridges, firewalls, packet shapers, switches, load balancers, and servers in a single device, wherein the network devices can be provided by any third party, and are interconnected to function as a network through

management software that enables drag-and-drop
configuration of the network devices, wherein
configuration of the network is performed through software
control and not physical rearrangement, and wherein a
5 complete Operating System provides full functionality to
the Open IP Services Platform.

[0022] These and other objects, features, advantages
and alternative aspects of the present invention will
become apparent to those skilled in the art from a
10 consideration of the following detailed description taken
in combination with the accompanying drawings.

Description of the drawings:

[0023] Figure 1 is a block diagram of a typical network
15 topology of the prior art.

[0024] Figure 2 is a block diagram that is made in
accordance with the principles of the presently preferred
embodiment.

[0025] Figure 3 is a block diagram that explains how
20 the Open IP Services Platform 30 incorporates a Level 4
switch router at the bottom level, and a general purpose

central processing unit (CPU) 34 at the top level.

[0026] Figure 4 is a block diagram that is provided to give greater detail to the configuration of the Open IP Services Platform.

5 [0027] Figure 5 is a block diagram of the software architecture of the present invention.

[0028] Figure 6 is a block diagram that illustrates the relationship between virtual NICs and the virtual interconnect.

10 [0029] **Detailed Description:** Reference will now be made to the details of the invention in which the various elements of the present invention will be described and discussed so as to enable one skilled in the art to make and use the invention. It is to be understood that the following description is only exemplary of the principles of the present invention, and should not be viewed as narrowing the claims which follow.

15 [0030] The present invention encompasses a range of improvements that by themselves and in combination are novel inventions. The fundamental building block of the

20

invention is a new type of network device (hereinafter referred to as the "Open IP Services Platform"). The Open IP Services Platform is capable of functions that are found in no other device. To understand the advantages of this Open IP Services Platform, it is helpful to name a few network devices, and explain how their functions are all performed by the present invention.

[0031] Typical network components include but are not limited to routers, bridges, firewalls, packet shapers, switches, load balancers, and servers. These devices can all be found on a first side of the router, wherein on the second side, the router functions as a gateway to networks such as LAN segments, WANs, and the Internet or other global information networks. The specific topology of these networks on the first side of the router can vary significantly depending upon the needs and functions of the local network segment. Thus, several of the problems that the present invention overcomes include 1) the total number of physical devices that may be required for a network, 2) the number of wires that must be installed between the devices, 3) the time required to configure the devices, 4) the level of knowledge of the person that is

installing the devices, 5) an understanding and memory of the specific topology that has been set up, and 6) the ability to reconfigure a topology on-the-fly.

[0032] The presently preferred embodiment of the

5 invention is able to overcome these problems for several reasons. First, all of the network devices can be physically disposed within a single unit, or Open IP Services Platform. Obviously, there are many obstacles that must be overcome to do this. For example, the Open
10 IP Services Platform of the present invention is constructed to accept network components from third parties. In other words, it is not a feature of the present invention to provide these network components, rather it is an aspect of the invention to provide a
15 device that can house them in the Open IP Services Platform. Not only can these network components be disposed within the Open IP Services Platform, but more than one type of network component can be housed together. Essentially, all of the network components listed
20 previously can be housed within a single unit of the Open IP Services Platform.

[0033] In order to dispose these network components

together so that they function, several novel elements of the present invention had to be developed. A first aspect was a system for configuring the interconnections between the network components in the Open IP Services Platform.

5 Consider multiple switches and a packet shaper disposed within the Open IP Services Platform. The packet shaper must be coupled to specific ports of the multiple switches. It is a novel aspect of the invention to provide a software package COREVISTA WEB(TM) that provides
10 configuration control by physically interconnecting network devices that are stored within the Open IP Services Platform. Control is provided at what can be considered to be two levels. The first level of control enables the user to make specific port assignments if the
15 system administrator is experienced, while the second level of control takes specific port assignments out of the hands of the administrator, and allows the specific configuration of ports to be left to the configuration software if the system administrator has only a limited
20 understanding of network topology.

[0034] It should be mentioned that the software package for configuration and management of the device is simple

enough to operate that a network specialist does not have to be brought in to set up the Open IP Services Platform. This aspect of the invention is made possible because the interface provides drag-and-drop configuration, as well as pre-configured loads.

[0035] With this brief introduction, the presently preferred embodiment of the invention is shown in figure 2. Figure 2 illustrates that all of the network services provided by individual network components 18, 20, 22, 24, 26, 28 have been replaced by a single Open IP Services Platform 30. It should be remembered that any or all of the functions of the network devices described above can be replaced as desired.

[0036] Figure 3 is a block diagram of the presently preferred embodiment of the present invention. This figure is provided to illustrate that the Open IP Services Platform 30 incorporates a Level 4 switch router 32 at the bottom level, and a general purpose central processing unit (CPU) 34 at the top level. It should be mentioned that while a general purpose CPU is preferred, any type of specialty CPU can be substituted. The reason for preferring a general purpose CPU is that it is going to be

more flexible. In other words, the Open IP Services Platform 30 can do more than just function as a unit for consolidating network functions if it is given more processing power and ability to run more programs. These other capabilities are addressed in a simultaneously filed application. The drawback is that a specialty CPU can be faster. However, given the fact that general purpose CPUs have increased in operation capabilities so rapidly, it is unlikely that the CPU would be a bottleneck to performance for most situations where the Open IP Services Platform is deployed.

[0037] The switch router 32 communicates with the CPU 34 via an internal Peripheral Component Interconnect (PCI) bus 36. Presently, that translates into a communication conduit of 240 Mbps between those components 34, 36. However, the switch router 32 is communicating at wire speed with network components in levels 2-4.

[0038] It is noted that it would take an OC-3 connection to the Internet for the input to the Open IP Services Platform 30 to exceed the processing throughput capabilities of the CPU used in the preferred embodiment. The OC-3 type of connection is uncommon to most

businesses, and thus the present invention is going to handle almost all connection scenarios without becoming a bottleneck.

[0039] Figure 4 is a block diagram that is provided to give greater detail to the configuration of the Open IP Services Platform 30. The CPU 34 is preferably a single board computer (SBC) operating with an INTEL(TM) chipset. The preferred microprocessor for the SBC 34 is an INTEL(TM) PENTIUM(TM) III. The SBC 34 communicates with memory in the form of SDRAM DIMMs 38, and possibly an array of hard drives/flash drives 40. The hard drives/flash drives 40 are optional, depending upon the needs of the network or of the network components being incorporated into the Open IP Services Platform 30, as will be explained.

[0040] The switch router 32 is shown coupled to the SBC 34 via the PCI bus 36. The switch router 32 has also been labeled as a network accelerator to more fully describe its function. The switch router 32 is shown as providing the port connections to external networks via the Gigabit Ethernet Fiber (GBIC) Ports 42, 10/100 Mbps Ethernet (Base T) Ports 44, PCMCIA Expansion Ports 46, and additional PCI

Expansion Slots 48.

[0041] The PCI Expansion Slots 48 are designed to receive the hardware of the network function being installed. In other words, a third party network function card is installed in one of the PCI Expansion Slots 48, enabling the Open IP Services Platform 30 to function as a load balancer, a firewall, etc.

[0042] It is also noted that optional cards 50 can also be installed into the PCI Expansion Slots 48. These optional cards can include such functions as OC-3, DSL modem, T1/E1 termination, and SCSI RAID. Thus it is seen that the Open IP Services Platform 30 is not fixed in its configuration or its function.

[0043] Figure 5 is a block diagram of the software architecture of the present invention. The Operating System 52 is preferably one that has an open architecture. This selection of an open architecture OS was made so that the system administrator is given the ability to modify the operating system itself, if necessary, in order to obtain the desired operation of the invention, without having to depend on others to provide the desired capabilities.

[0044] Another advantage of utilizing an open architecture OS is that some users will want to drop their own software into the Open IP Services Platform 30.

Unfortunately, this flexibility also enables users to

5 write code that can potentially interfere with the other functions in the Open IP Services Platform 30.

Advantageously, the complete OS provides memory management that prevents third party software from jeopardizing the operation of any other network functions taking place.

10 **[0045]** The Open IP Services Platform 30 is also operated by a multi-tasking operation system. In the presently preferred embodiment, a stable and secure OS is desired. The Open IP Services Platform 30 is currently operated using FreeBSD or Linux. It is also important to
15 understand that the OS operation within the Open IP Services Platform 30 is not what is typically referred to as an embedded OS. An embedded OS is often a smaller and less capable version of the complete OS. The present invention utilizes the complete OS so that all
20 capabilities of the OS are available. These capabilities include the all-important security features.

[0046] The Operating System 52 executes third party

applications 54, with the global rules 56 including management, statistics, and Quality of Service flow rules, and network services rules 58. Network service rules 58 include restrictive flow control, security, a DNS server, file services, bandwidth metering, a DHCP server, a firewall, and external service packs.

[0047] The Operating System 52 communicates with the interface 60 of the SBC 34. This communication is controlled via policy interface 62. Virtual interconnects 64 handle the translation within the SBC 34 of mapping virtual NIC instantiations 66 to physical port instantiations 66.

[0048] Presently, the invention includes two different system configurations, the ECREACTOR 3000(TM) and the ECREACTOR 5000(TM). There are several common features in these products including: two Gigabit GBIC Ports 42, twenty four 10/100 (Base T) Ports 44, a single 733 MHZ PENTIUM(TM) III CPU 34 that is ungradable, 32 MB of RAM and 32 MB of Flash RAM 38, both ungradable, two USB ports, one serial port that is optional, and two PC card slots 46, type 2. The devices are different in that there are two PCI bus slots, and an optional hard drive on the

ECREACTOR 3000(TM). In contrast, the ECREACTOR 5000(TM) includes four PCI bus slots, and comes with two RAID bays for up to 6 hard drives, and a redundant power supply. Both systems are configurable via local PC, serial port, modem, or via a network connection. More control is possible, however, using a configuration program that operates in the WINDOWS(TM) environment.

[0049] It is observed that presently both systems run FreeBSD 4.2 and Linux Kernel 2.2.17 (RedHat 6.2 or 7.0, Mandrake 6.2) Operating Systems. However, a PC running any Operating System can communicate with them via Telnet or a command line interface. But the software configuration tool, COREVISTA WEB(TM), is currently a WINDOWS(TM) application.

[0050] Other important statistics of the systems are that the address table size is 16K IP and 8K IPX addresses with no per port limits, and more available via aging. The systems also include an RS-232 console port that supports remote monitoring and diagnostics via a DB-9 (DTE) connector. Pre-set configurations include, but are not limited to, internal and external T1, DSL modem, analog modem, and others. A store-and-forward forwarding

mode is available. Filtering modes are destination-based, multicast address-based, or port based. 1K virtual LAN support is also provided.

[0051] Upgrades to the Open IP Services Platform 30 are also available using the FTP protocol via Flash PROM.

Additional features include port priority, port aggregation (multi-link), port mirroring for RMON probes, and link aggregation and redundancy where up to 8 ports can be configured as a single 800 Mbit link.

[0052] When considering how the present invention is different from the state of the art, the present invention hooks the networking functions into a server to make network functions more seamless. In other words, instead of just operating as a Network Interface Card (NIC) tied into a switch or router, the present invention provides full control over the switch and router functions. This approach is different from the state of the art because no one has previously tried to provide this type of interface that enables a third party to load their own components into a box providing some type of network function. In fact, this approach is antithetical to the business model of any other network function provider. For it is the

desire of suppliers of network functions that the user not try to add hardware or software components of a third party into their own box. Obviously, this type of approach severely limits trying to build a "best of class" network if a user can only install certain brands of products when interoperability is a must.

[0053] Thus, the present invention performs the unique function of being an integrator of network products that have previously required separate boxes or isolated operation in order to function. Advantageously, the present invention does not have to try and provide any of the network functions themselves, but instead provides a box that enables network cards performing all manner of functions to be disposed therein, while providing the hardware and software to make interconnections between the different network cards. Thus, even though the present invention does provide switch/router capabilities, even these functions can be replaced or enhanced by the addition a third party switch or router card.

[0054] Another way to look at the invention is seen by examining its use of virtual NICs. Using virtual NICs, in the sense that they present a standard interface like a

normal driver, up to the services and stacks above it in the software, so that the software believes it is communicating with a normal driver. A novel aspect of the invention is to be able to dynamically remap it to other services within the Open IP Services Platform. This means the data does not have to be serialized/deserialized. This also gives the present invention the ability to remap to physical ports down through the bottom end of a networking stack. Another advantage is the ability to create rules based on a specific interface. Thus, the use of virtual NICs provides the invention with the ability to map process to process.

[0055] Another use of the virtual NICs has to do with memory allocation. Typically, a pool of memory resides with the driver. Memory is handed off to other resources as needed. Memory, in this case a buffer, is eventually released and given back to a driver. An important aspect of the invention is to share all of the buffers across all of the virtual NICs.

[0056] For example, consider a packet of data received by a router installed in the Open IP Services Platform.

The router would have down a tag or pointer for data stored

in a buffer to a virtual NIC interface, which would hand
the tag to a firewall. Thus, the data in a buffer is no
longer being transferred or copied from buffer to buffer
as each new process receives the data in the buffer, but
5 instead the data remains in the same buffer, and control
of the tag to the buffer is what is passed from process to
process. Thus, the Open IP Services Platform becomes very
fast and very efficient in its handling of packets because
the present invention utilizes the virtual NICs or virtual
10 interconnect that handles buffer data management across
the services, rather than individually. Thus, buffer
management is done globally, but handled at a low level.
Thus, the allocation of memory in the buffer pool is known
at all times because buffer management is being handled
15 globally.

[0057] To help understand the aspects of the invention
described above, figure 6 is provided to show how virtual
NICs (VNICs) are utilized. Figure 6 shows three services,
A 70, B 72, and C 74. A VNIC is shown coupled to each of
20 the services, thus providing VNIC A 76, VNIC B 78, and
VNIC C 80. Each of the VNICs is coupled to the virtual
interconnect 82 of the Open IP Services Platform 30. The

services 70, 72, and 74 pass pointers or tags to data stored in a global managed memory buffer. By having the VNICs A 76, B 78 and C 80 pass pointers or tags to each other instead of having to actually copy the data in the buffers, overhead is reduced. The ASIC 84 is shown to explain that the services can be broadly defined. It is noted that the virtual interconnect 82 can be controlled by rules that are user defined. The rules determine what data can be passed to particular services. The virtual interconnect 82 is also responsible for packet redirection, or in other words, passing of pointers to the data in the buffer from one service to another service. The virtual interconnect 82 can also perform multicast copying and management. The virtual interconnect 82 becomes a flow mechanism among software instead of a serialization/deserialization process. The virtual interconnect 82 is both software and routing between stacks on the same processor, and it is also hardware in that the hardware interconnections are configured between ports.

[0058] The virtual interconnect 82 is one of the aspects of the invention that makes it possible to add

multiple functions to a single processor, but also to work in the opposite direction. In other words, a single service can be spread out across multiple processors. Thus, when a processor determines that it does not have
5 enough processing power available for a particular service, a portion of the services can be redirected at wire speed to another processor.

[0059] An interesting use of this virtual NIC technology is utilizing it with VLANs. Not only is it
10 possible to control ports on a port by port basis, the present invention enables control on a virtual port basis out through VLANs. Thus, a port in the Open IP Services Platform can be assigned to a group of services that do not even have to be present in the Open IP Services
15 Platform. For example, consider two Open IP Services Platforms coupled together. The services in a first Open IP Services Platform can be assigned to a port in a second Open IP Services Platform. The present invention has thus added the ability to hook a driver into an application
20 that maps to an outside port. This is done using the tagged VLAN mechanism.***

[0060] Another aspect of the invention to consider is

the combining of a server and switch. By doing so, the server has full access to all the data because the server has all of the protocols. Thus, the switch becomes a full router, with the ability to process and manipulate the data. Consider the advantage of being able to serve data immediately to a port so that the network itself does not become a bottleneck. For example, a typical network infrastructure limits speed of data to the 100 Mbit or 1 Gbit data pipes. But by merging the server and the switch together, data now moves at the speed of the bus in the server, which can be much greater. Furthermore, providing multiple system buses within the server provides the function of scalability by using the Open IP Services Platform 30.

[0061] One of the novel aspects of the invention is that because the present invention is not trying to duplicate the functions of a proprietary firewall, call it Firewall A, there are no licensing fees to be paid because Firewall A is purchased and put into the Open IP Services Platform 30. The Open IP Services Platform 30 thus provides all of the functionality of Firewall A because it is the actual Firewall A. Likewise, Load Balancer B is

manufactured by a different company, is purchased, and disposed within the Open IP Services Platform 30 next to Firewall A. Firewall A and Load Balancer B now provide all of their functionality in a single box. All
5 interconnections between them are provide by the present invention down to a port-by-port basis.

[0062] Another novel aspect of the invention is that it prevents exclusivity of function. Suppose that the manufacturer of Firewall A enters into an exclusive
10 contract such that it is no longer available for use in the Open IP Services Platform 30. Advantageously, Firewall A is removed and Firewall B is put in its slot. After loading Firewall B's drivers, it is likely that no other configuration of Firewall B will be required. The
15 firewall functions will operate as before.

[0063] It is another aspect of the invention that most network functions can be added into the Open IP Services Platform 30 without modification. The only requirement is that the driver for the network function be provided for
20 the OS that is running on the Open IP Services Platform 30.

[0064] Another aspect of the invention is that the Open

IP Services Platform 30 can communicate at wire speed with other Open IP Services Platforms. This is advantageous when, for example, a particular function is not being performed fast enough in one particular unit. Just one
5 function can be rerouted at wire speed to another Open IP Services Platform 30.

[0065] Consider an Open IP Services Platform 30 that is performing the functions of a server that is providing FTP, web services, mail services, etc. It is possible to
10 assign any of the services to different servers (Open IP Services Platforms 30), at wire speed, to keep performance at a desired level. The present invention can also reconfigure the Open IP Services Platform 30 on the fly such that when certain performance bottlenecks are being
15 reached, the Open IP Services Platform 30 will reassign functions as previously defined by the administrator.

[0066] Another feature of the present invention is that both configurations of the Open IP Services Platform 30 provide keyboard, mouse, and monitor ports. Thus, the
20 Open IP Services Platform 30 is a full-fledged server that a developer can work on directly.

[0067] It is observed that the physical dimensions of

the Open IP Services Platform 30 are also industry standard for use in data centers and other facilities that use rack mounted equipment. The dimensions vary from a 1U-high to a 3U-high unit that are rack-mountable.

5 **[0068]** Another novel aspect of the invention that increases versatility is the type of environments in which the Open IP Services Platform 30 can operate. Small businesses are often stashing network components into closets or other tight spaces. This closed environment
10 typically runs hotter than a room with its own thermostat. Accordingly, the Open IP Services Platform 30 would normally run at a higher than optimal temperature. Another aspect of the invention is to provide a solid state refrigeration unit. This aspect is especially
15 important when considering the commercial and industrial locations where the Open IP Services Platform 30 will be used. This is also more important for the ECREACTOR 5000(TM) model that includes hard drives. Hard drives are especially vulnerable to high operating temperatures. The
20 refrigeration unit can be disposed just on the hard drives themselves.

[0069] With these features in mind, it is useful to

consider the manner in which the present invention
utilizes them to achieve novel advantages, while observing
that the advantages are available to all of the targeted
core markets of SPs, LECs and Enterprises. First, the
5 invention provides a consolidated equipment solution.

Managing a wide array of single-function, multi-vendor
network devices creates high installation and management
costs. The present invention consolidates the many
functions performed by the individual network devices.

10 The equipment consolidation can be partial or total, with
a single device replacing entire racks of physical
equipment. Consolidation of network functions solves a
critical long-term build-out problem in Enterprise IT
rooms, SP data centers, and in LEC central offices where
15 equipment proliferation often overwhelms available power,
air conditioning or physical space limitations.

Consolidated equipment means that there are fewer
interconnections, fewer cables, and fewer moving parts to
fail, resulting in increased uptime and reduced ongoing
20 support costs.

[0070] Consolidated network equipment greatly
simplifies installation and ongoing maintenance. The

present invention includes an elegant, intuitive,
centralized management application, COREVISTA WEB(TM),
that enables installation in less than 15 minutes. Thus,
the administrator can deploy units without needing to
5 complete multiple, vendor-specific, certified training
programs as will be explained. The present invention even
offers self-configuring features on base units.

[0071] The flexible allocation of network resources is
made possible because software is used to make all
10 connections between network devices installed in the
present invention. Any single or combination of virtual
or physical ports can be instantly reassigned new IP
services on a port-by-port basis. This enables the
administrator to reconfigure IP services as needs change,
15 and without taking down any part of the network. This
aspect is especially critical to large Enterprises, and
almost any SP and LEC.

[0072] One of the greatest advantages of the present
invention is the use of open IP standards. Proprietary
20 technologies are often initially attractive because lower
costs can be achieved for a specific function.
Disadvantageously, however, proprietary technologies often

limit selection of complementary equipment, leaving the network function isolated and unexpandable. Additionally, proprietary equipment can preclude the use of certain IP services completely, and can require an administrator to provide specialized training for staff. Thus, hidden costs add up and quickly surpass any initial savings.

[0073] The present invention delivers a truly open architecture communications platform specifically designed to enable rapid deployment of "best in class" applications and value-added services for mission-critical communications, while preserving existing infrastructure. The present invention also enables the administrator to offer any IP service through the Enterprise, SP or LEC.

[0074] Configuring the Open IP Services Platform 30 can be performed in various ways. To drag and drop icons representing the network components requires that the administrator access the Open IP Services Platform using the COREVISTA WEB(TM) configuration program. In contrast, access over the web using COREVISTA WEB(TM) enables the administrator to configure what is already loaded in the Open IP Services Platform 30, but not to design the layout. In other words, it enables the administrator to

configure what is already loaded, but not change the layout.

[0075] When performing configuration over a network, it is noted that SSH is provided for a secure and encrypted configuration session.

[0076] One useful feature is that the configuration can be stored on and loaded from a PC card. Thus, if an SP or LEC needs twenty identical Open IP Services Platforms 30, only one has to be manually configured using the COREVISTA WEB(TM) configuration program. The configuration is then stored on a PC card that can be duplicated. The administrator then only has to insert the PC card into a non-configured Open IP Services Platform 30, and load the configuration.

[0077] Both the ECREACTOR 3000(TM) and the ECREACTOR 5000(TM) Open IP Services Platforms include a host of standard software applications right out of the box. These software applications include an APACHE(TM) web server, SQL(TM)-based database management, various drivers and interface for the ports and other hardware, DHCP, IPB4 router, network access translation (NAT), a restrictive flow packet shaper, SNMP, point to point protocol (PPP), a

virtual private network (VPN), a virtual LAN (VLAN), SSH tunneling. Some Open IP Services Platforms can also include a SAMBA server, DNS, a POP mail server, and full software or hardware RAID functionality.

5 **[0078]** The present invention also provides a standardized interface to all of the network cards that can be loaded. This interface is SQL-based to enable full control over access to the network functions. It is also a function of the invention to provide ActiveX modules for
10 each network function that is being added. The power of this feature is that, for example, the ActiveX module can be input to a spreadsheet. As the network is operating, the spreadsheet is displaying all of the statistics of that network function in realtime.

15 **[0079]** One of the advantages of the present invention that may not yet be apparent is that it includes a central point of configuration control. Each network card has an associated database and ActiveX component. Thus, two firewalls can be configured in exactly the same way.
20 Obviously, each firewall card requires its own unique driver and instruction set because they are probably proprietary systems. Surprisingly, both of the firewall

cards can be controlled using the identical ActiveX
component and the same database. The present invention is
able to provide a centralized, standard interface program
that performs the translation between the database and the
5 firewall cards themselves.

[0080] It was stated previously that the present
invention provides allocation of network resources at the
port, protocol, and IP address level. In other words, it
is possible to control and thus sell IP services on a
10 port-by-port basis. It is useful to examine several
examples of how this works.

[0081] Consider an office building with four tenants,
A, B, C and D. In a packet shaper that comes with the
ECREACTOR 3000(TM), each of the tenants can be allocated
15 Internet access by a rule set, trigger point, or manually.
Rule sets are used to allocate resources. For example,
the tenants can share a T1 line equally, where each tenant
is restricted to 300 kb of bandwidth. A trigger point is
used to activate particular rule sets, depending upon the
20 conditions. Finally, it is possible to manually override
the rule sets and trigger points.

[0082] A first example is when none of the tenants are

restricted to the amount of bandwidth that they can use.
Therefore, tenant A may use 800 kb of bandwidth without
interfering with the other tenants. Then, tenants B, C,
and D all need 200 kb of bandwidth. At this point, the
5 bandwidth of the T1 is exceeded. A trigger point can be
set so that when bandwidth demand exceeds the maximum
available bandwidth, the tenants are restricted. The rule
set that is activated can divide all the bandwidth
equally, or still favor the heaviest bandwidth user while
10 reducing the bandwidth to that user.

[0083] Bandwidth can also be allocated according to the
type of activity that is being performed. Thus, activity
can be restricted based on protocol, or the type of
activity that is occurring. Thus, all tenants can be
15 given unrestricted flow control on e-mail, but restricted
flow on web browsing or FTP.

[0084] It was mentioned that flow control can be
managed down to a single port. For example, there can be
three ports, each port having a unique firewall and flow
20 control configuration.

[0085] Another feature of the present invention when
rules and trigger points are useful is when access is

suddenly restricted to the Open IP Services Platform 30
itself. For example, a cable in the ground is cut by some
construction activity. The Open IP Services Platform 30
can reconfigure itself based on the total available
5 bandwidth that it sees. Thus, when a T1 line is cut, and
the dial-up access becomes the only way to get out on the
Internet, all users may be severely restricted, and yet
enable vital services such as email. However, access to
web servers behind the Open IP Services Platform 30 from
10 the outside may have to be eliminated to ensure email
access.

[0086] Not only can access to outside networks be
dynamically allocated, but it is also possible to perform
access metering. Thus, if a tenant desires to be charged
15 only for actual use of access to an outside network, this
can be done.

[0087] It is important to realize that the scenarios
described above are available only because all of the
network functions are disposed within a single box that
20 can reconfigure itself on the fly.

[0088] The specification above is specifically
addressed to the novel aspects of the hardware and

software integration of third party network cards.

However, it is mentioned that the COREVISTA WEB(TM) is also considered a novel aspect of the invention, as is the unique database structure that enables the configuration

5 software to function with and configure all the third party network cards that are disposed within the Open IP Services Platform 30. However, all of the functionality of these other novel aspects of the invention are not required for the invention to function. What is important

10 is that a common SQL database structure be provided that enables each network function to be controlled thereby.

Regarding the configuration software, it is only necessary that each network function be controlled by an ActiveX module that is linked to an SQL database. Thus, a

15 consistent interface to the actual network cards is provided. Furthermore, third parties can develop and deliver their own ActiveX module for their network component.

[0089] By assigning each ActiveX module to its own SQL
20 database, each network component is able to have its own password to its functionality. Therefore, an administrator can have a unique password for each network

component, thereby allowing access to specific modules without compromising the entire network configuration.

5 **[0090]** The other advantage of SQL databases is that each module can be controlled by a set of rules. These rules can be manually triggered, or automatically triggered by an event. The events can be time-based or triggered by network conditions. Likewise, bandwidth usage can be restricted when the demands outstrip the available supply. These events can even trigger a call for
10 help to a system administrator or to another designated party.

15 **[0091]** This flexibility in control of the aspects of the Open IP Services Platform enable unprecedented opportunities. For example, a business can provide Internet access to any other business in a building, thus operating as a mini-Internet Service Provider (ISP). Bandwidth can be dolled out in any desired increments to users. The bandwidth can even be controlled down to the port on a switch.

20 **[0092]** It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the present invention. Numerous

modifications and alternative arrangements may be devised
by those skilled in the art without departing from the
spirit and scope of the present invention. The appended
claims are intended to cover such modifications and
5 arrangements.

11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000